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SMALL DIAMETER CAN END WITH LARGE OPENING

The present invention relates to can ends having a non-removable tear panel which defines a large opening for improved pour characteristics, so called large opening ends (LOE). In particular, the invention relates to the shape of such large openings in can ends having a reduced diameter centre panel.

Typically, aluminium or steel cans filled with beer, soft drinks or the like are provided with easy open, stay on tab type ends having a non-removable tear panel which is torn and swung down into the can to provide an opening through which the contents of the can may be dispensed. The opening provided in conventional cans is generally small and as a consequence it is not possible to pour the contents from the can in a smooth manner because the liquid tends to be dispensed in small spurts or glugs. This is particularly difficult where the contents are being drunk directly from the can as the glugs mean that the liquid has to be sipped.

Can ends having larger openings have been proposed, for example in US 5,711,448, in order to improve pourability and drinkability. This improved performance is usually obtained by providing openings of larger area than the conventional openings discussed above. The pour characteristics of these large openings allow the contents of the can to be dispensed at higher flow rates than conventional openings, with fewer spurts or glugs. This allows the contents of a can to be drunk directly from the can, in a more natural manner.

Can ends are made in a variety of sizes from 202 to 211 (using conventional can makers' terminology).

However, there is continual pressure to reduce the size of can ends. Recently, 206 ends were conventionally used for all beverage cans and these size ends are still used on the majority of beer cans in Europe. However, on cans for soft drinks, 202 ends are now the industry standard in both the US and Europe and there is industry pressure to reduce the remaining 206 ends to 202 ends. Thus, cans are being produced with successively smaller diameter ends in order to provide cost savings through lightweighting.

Furthermore, it has been proposed to reduce the diameter of the centre panel of the can end whilst retaining the nominal can end diameter, as discussed in WO 96/37414. Such can ends have an outer circumferential "hook" which is separated from a smaller diameter centre panel by an inclined side wall. The side wall is inclined at an angle of between 20° to 60° to the plane of the centre panel.

As centre panels become smaller (either through reducing the size of the can end or through the use of inclined side walls) it becomes more difficult to provide an opening having the area considered necessary to obtain improved pouring and drinking performance, due to the reduced distance between the rivet and the side wall of the end panel.

The aim of the present invention is to provide an easy open, stay on tab can end, having an opening with improved pourability and drinkability characteristics but suitable for use on ends having a smaller diameter centre panel than conventional, standard 202 ends. Hence, the present invention is suitable for use on 202 ends having

sloping side walls as previously discussed and on smaller diameter standard ends, such as 200 and below.

Accordingly, the present invention provides an easy open can end comprising a circular centre panel with a rupturable score line therein, the score line defining the periphery of a non-removable tear panel, a non-detachable tab having a nose portion and a rear portion, and a connection between the tab and the centre panel which acts as a pivot about which the tab can be rotated out of the plane of the centre panel, such that in use, the rear portion of the tab is lifted to cause the nose portion of the tab to press down on the tear panel, thereby rupturing the score line and swinging the tear panel out of the plane of the centre panel to create an opening, the opening having a major axis and a minor axis, the minor axis located on a diameter of the centre panel and the major axis located perpendicular to said diameter, characterised in that the diameter of the centre panel is less than 1.835 inches (46.6 mm) and the opening has an area of less than 0.5 square inches (323 mm^2) and an aspect ratio (major axis : minor axis) of between 1.3 and 1.7.

All centre panel dimensions quoted in this specification relate to the dimensions of the die used to produce the centre panel. Thus the centre panel diameter quoted is the internal panel diameter of the centre panel.

The inventors have discovered that the pourability and drinkability characteristics of the opening in a can end are affected more by the aspect ratio and orientation of the opening than by its area. Hence, the opening in a

can end having a smaller diameter centre panel can be designed with greatly improved pourability characteristics without increasing the area of the opening above the threshold value of 0.5 square inches stipulated in the cited prior art.

The criteria for assessing a good LOE is that the flow rate from the can opening, with a "vent" space above the surface of the liquid, should exceed that which can be swallowed by the average consumer. This allows the average consumer to drink the contents of the can in a natural manner, without any spurts or glugs. When the flow rate from the opening is too low, the consumer will tend to tilt the can further, to increase the flow rate, and this cuts off the air space above the surface of the liquid, causing glugging. Alternatively, in order to obtain smooth pouring, the consumer will have to sip the contents of the can due to the low flow rate.

Considering a can end having an opening in which the minor axis of the opening lies along a diameter of the end and its major axis lies perpendicular to such diameter, significant improvements in pourability may be obtained by providing a tear panel (and hence an opening once the tear panel is torn and swung back into the can) with an aspect ratio of between 1.3 and 1.7 (major axis : minor axis), preferably with an aspect ratio of about 1.5.

When the aspect ratio is below 1.3, the opening in the can tends towards a circular shape as in conventional ends. The flow rate from such openings tends to be low and the consumer then tilts the can further than is desirable to obtain a higher flow rate, resulting in

unsatisfactory glugging. When the aspect ratio is above 1.7, the opening in the can tends towards an elongated shape which means that even slight variations in the tilt of the can results in large variations in the flow rate. Hence, at aspect ratios above 1.7, the flow rate from the opening is too sensitive to variations in the tilt of the can. This means that too much precision is required by the consumer to obtain the required flow rate, without blocking the air passage above the surface of the liquid.

Preferably the opening is elliptical, as this is the most suitable shape to provide the required aspect ratio whilst ensuring that the pivotal movement of the tab is sufficient to fracture the score line along its entire length. However, enhancements to the tearing of the score line may be achieved by using an enhanced tab design or by providing a bead configuration which strengthens the centre panel around the score line and tab.

Preferably, the can end also comprises a bead on the tear panel which substantially follows the outline of the score line but which is shaped around the front of the nose of the tab. This bead configuration helps to strengthen the tear panel and prevent it from being distorted as it is opened, thereby assisting rupture of the score line along its entire length.

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a plan view of one embodiment of a can end according to the invention.

Figure 2 shows a side section through the can end shown in figure 1.

Figure 3 shows pour rate data for various 202 ends with different aperture sizes (showing 202 Standard, 202 LOE and 202 LOE with reduced diameter centre panel).

Figures 1 and 2 show a can end 1 according to one embodiment of the invention. The can end 1 has a sloping side wall 2 and a centre panel 3 of reduced diameter, D (as shown in Figure 2). The centre panel 3 is marked with a rupturable score line 10 which defines a tear panel 11. The score line 10 has an open configuration and the unmarked area between the start and finish of the score line 10 defines a hinge 12. The can end 1 also comprises a tab 20 having a nose portion 21 at one end, which extends over the edge of the tear panel 11. The other end of the tab 20 is provided with a rear, lifting portion. The tab 20 is connected to the centre panel 3 by a rivet 25 positioned adjacent to the score line 10, on the other side of the score line to the nose of the tab 21. The tear panel 11 is provided with a closed, raised bead 15 which follows the periphery of the tear panel 11 and the nose of the tab 21.

To open the can, the rear portion of the tab 20 is raised and the tab 20 pivots out of the plane of the centre panel 3 about the rivet 25, pressing the nose of the tab 21 against the tear panel 11 adjacent to the score line 10. This movement initially ruptures the portion of the score line 10 which extends below the tab 20 and allows any gas which has built up within the can to vent (the "pop"). As the tab 20 is raised further, rupture of the score continues around the periphery of the score line 10 and the tear panel 11 swings out of the plane of the centre panel 3, into the body of the can

about the hinge portion 12, defining an opening in the can end 1. The bead 15 on the tear panel 11 provides stiffness and prevents the tear panel 11 from distorting as the end 1 is being opened. This in turn assists the propagation of the rupture of the score line 15 around the periphery of the tear panel 11 to the hinge portion 12. The resultant opening has a minor axis, which lies on a diameter X-X of the end 1 and a major axis Y-Y, which lies perpendicular to this diameter, at the point where the opening has its maximum dimension along this axis.

As shown in figure 1, when the centre panel 3 is of reduced diameter, the minor axis of the opening is restricted by the reduced distance between the rivet 25 and the start of the side wall 30. This means that it is difficult, to obtain an opening having an area of greater than 0.5 square inches (323 mm^2), as stipulated in the prior art as the size of opening required to obtain improved pouring performance. However, the applicants have found that improved pouring performance can be obtained from an opening having an area less than 0.5 square inches (323 mm^2), provided the aspect ratio of the opening (major axis : minor axis) is between 1.3 and 1.7.

The applicants have carried out a number of tests to measure the pour rates of cans fitted with ends having various size apertures and centre panels. In these tests, the test can was opened and then rotated from a vertical to horizontal orientation in three seconds. The contents of the can were allowed to flow freely from the can and the flow rate measured at predetermined, constant time intervals.

Figure 3 shows the results of these tests for three 202 ends with differently configured centre panels and aperture size: A conventional 202 LOE, A; a 202 LOE according to the invention with reduced diameter centre panel, B and a conventional 202 end with standard size opening, C. As shown in figure 3, the conventional 202 end, C, with an opening of area 0.450 square inches (290 mm^2) and an aspect ratio of 1.1, exhibited fluctuations in flow rate (glugging) and took the longest time to reach its maximum flow rate. The 202 LOE, A, with an opening of area 0.596 square inches (384.5 mm^2) and an aspect ratio of 1.47, showed far fewer flow rate fluctuations and reached a significantly higher maximum flow rate in the least time. However a 202 end according to the invention, B, having a reduced diameter centre panel and an opening of area 0.487 square inches (314 mm^2) and an aspect ratio of about 1.5, was found to exhibit significantly improved pouring characteristics (with fewer flow rate fluctuations and improved flow rate versus time profile) compared to the standard 202 end. The flow rate versus time profile for the 202 LOE according to the invention, B, shows a performance comparable to that of the known 202 LOE, A.